VII. Window into Agriculture

"Cultivators of the earth are the most virtuous and independent citizens.

– Thomas Jefferson

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7.1 Introduction

Agriculture has been the dominant industry in Virginia from the beginnings of human settlement. Native Americans began by gathering and domesticating wild plants. The cultivation of corn began in Mesoamerica and spread into Eastern America around 900 A.D., becoming the primary grain crop (Virginia Places). In 1607, the English settled in Jamestown, primarily looking for the easy riches and gold rumored to be in the New World. With the harsh winter of 1609-1610, illness and Indian attacks had threatened the existence of the colony, reducing the population from 350 people to 90. The colony was saved by the export in 1614 of the first cash crop – a shipment of tobacco to England. By 1619, over 10 tons of tobacco had arrived in England from Virginia (2). What began as a search for glittering gold ended as the finding of gold in a wrinkled, brown leaf.

Objectives

In this lesson students will:

- Discuss major environmental issues affecting the agriculture industry in the Piedmont Region, the Valley and Ridge Region, and in the Coastal Plain Region.
- Examine and demonstrate the environmental impact of agricultural practices.
- Introduce concept of sustainability.

SOLs

Science 6.1, 6.9; Social Studies USI.3

Key Terms/ Concepts

- Rural/Urban
- Sprawl
- Best Management Practice (BMP)
- Nutrients
- Erosion
- Watershed
- Sustainable Agriculture
- Fertilize
- Pesticides/Herbicides
- Eutrophication
- Point Source/Non-Point Source (NPS) Pollution

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7.2 Student Information

In terms of output value, agriculture is the biggest producer in Virginia, contributing 11.2 percent of the Gross State Product. As with any large industry, new challenges continue to arise. These challenges vary by region:

Coastal Plain Region (Tidewater)

Many farmers face growing concerns about chemical runoff. Most farms in this area produce field crops such as corn, soybeans, peanuts, and some cotton. In order to keep these crops free of insects and weeds that harm productivity, they use different chemicals. The concern is that these chemicals will run off, ultimately entering the groundwater supply and harming the Chesapeake Bay.

Piedmont Region (Northern Virginia)

Northern Virginia used to be an area of beautiful farmland. The amount of farms is being decreased by a phenomenon called "urban sprawl." As you know, Northern Virginia is home to our nation's capital and therefore thousands of jobs. Many people choose to live in the suburbs and commute 10-80 miles round trip to work. The problem is that as population continues to increase in the area, people are moving farther out into what used to be farmland. Planning for sprawl while preserving farmland is a big challenge for this area.

Piedmont Region (Central Virginia)

Many farmers in this region have historically grown tobacco. First, tobacco is a particularly difficult crop to grow because it requires manual labor, which is expensive to employ, and it depletes nutrients in the soil, which must be replaced to maintain fertility. Second, American farmers are having a hard time competing with imported tobacco.

Valley and Ridge Region (Shenandoah Valley)

Poultry is the primary industry in this region. Poultry production creates large amounts of waste. A problem is properly disposing of the waste. It contains high amounts of nitrogen and phosphorus, so it can be used as fertilizer to some extent, but there is concern that too much fertilization can cause water pollution as it has a tendency to run-off/seep into groundwater.

Solutions to these challenges can be found in Sustainable Agriculture – defined as providing a more profitable farm income, while promoting environmental stewardship and stable farm families and communities. For example, it can be applied to water quality, timber harvesting, urban sprawl, and erosion control. By implementing Best Management Practices, farmers can work to ensure that the environment is protected for future generations.

A valuable resource for grants, lesson plans, and more activities can be found at Agintheclass, sponsored by the Virginia Farm Bureau (www.agintheclass.com/teachers/lessonplans.asp).

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7.3 Teacher Content

Although the number of citizens directly involved in farming activities has decreased, (there were twice as many farms in 1960 as there are today) agriculture remains the top industry in Virginia. Agriculture and its associated business sectors contribute 11.2 percent of Virginia's Gross State Product, with around $36 billion in sales (Virginia). With variations in soil, climate, and resources, each region provides a different agricultural focus as well as varying challenges. A diverse state, Virginia's geographic regions possess unique agricultural resources and challenges.

Coastal Plain Region (Tidewater)

Pesticide Problems

Since Virginia's founding in 1607, agricultural production in the coastal areas has centered mainly on field crops, including soybeans, peanuts, and to some degree cotton. Currently, Virginia's main agricultural commodities are chickens, cattle, milk, turkeys, sod, and soybeans. The two main crops used for animal feed are soybeans and corn. As with any crops, insects and weeds pose a major challenge. Insects can destroy crops by eating the leaves and other parts of the growing plant. Weeds compete with the crop for resources in the soil, such as **nutrients** and water. Weeds can also be a problem if they are taller than the crop, blocking from the crop the sunlight it needs to grow and be healthy. In response to insect and bug problems, farmers often spread chemicals. Herbicides kill unwanted weeds. Pesticides kill or repel certain insects from the crop. The problems with chemical application to crops are water pollution, damaged soil quality, reliance on genetically modified plants, biomagnification.

Pesticides can have highly negative effects on water quality. If applied improperly, the chemicals can run off and/or seep into groundwater, causing non point source (NPS) pollution, or pollution which travels from distant locations. Another environmental issue with pesticides is the potential, if they get into local rivers, to be transported hundreds of miles, ending up in the Chesapeake Bay or other large water bodies. In 2008 the Chesapeake Bay Assessment rated its overall health at 38%, or 62% degraded, with agricultural pollution as a primary concern. This concern, along with many others, have increased the rules and regulations imposed on pesticide and herbicide spraying. (http://www.chesapeakebay.net/indicatorshome.aspx?menuitem=15038)

A characteristic that makes pesticides and herbicides good for killing unwanted plants and insects are their persistence. This means they are not naturally broken down. Being stored in animals, soil, and plants means they cause damage on a variety of levels of the food web. Biomagnification is the process by which chemical's concentrations increase in animals of higher trophic levels. This is the process that has endangered birds of preys' egg clutches, most notably the Bald Eagle.

Lastly, in order for plants themselves to not be harmed by pesticides, many are genetically modified to be tolerant of these toxins. Thus, an ethical concern is raised about whether we should be eating genetically modified organisms (GMOs).

Today there are many rules and regulations in regard to the uses of pesticides. These are especially important in the Coastal Areas of Virginia, because if the chemicals run off they could harm the Chesapeake Bay's water quality. Contents of the pesticides must be labeled. Some are considered for "general" use, where anyone can purchase and use them. Many of the chemicals applied to agricultural land, however, are "restricted" use. This means that one must have gone through training and be certified to spray these chemicals (Hetzel).

People certified to spray farm chemicals must also take protective measures themselves. Many of the chemicals used in the herbicides and pesticides are poisonous. The sprayers must wear protective suits, gloves, facemasks, goggles and boots to protect their entire body from the dangerous chemicals (Hetzel).

Piedmont Region (Northern Virginia)

Losing Farmland

Agriculture in Northern Virginia and other **urban** areas is diminishing due to unplanned or poorly planned sprawl. Urban **sprawl** is where metropolitan areas (cities) are growing and expanding at the fringes, pushing development into **rural** areas (Edelman). This is causing some small farmers to sell their farms to commercial ventures, resulting in conflicts and hard feelings between agriculturalists and environmentalists versus business people. Urban sprawl has been a popular means of development for many years for several reasons:

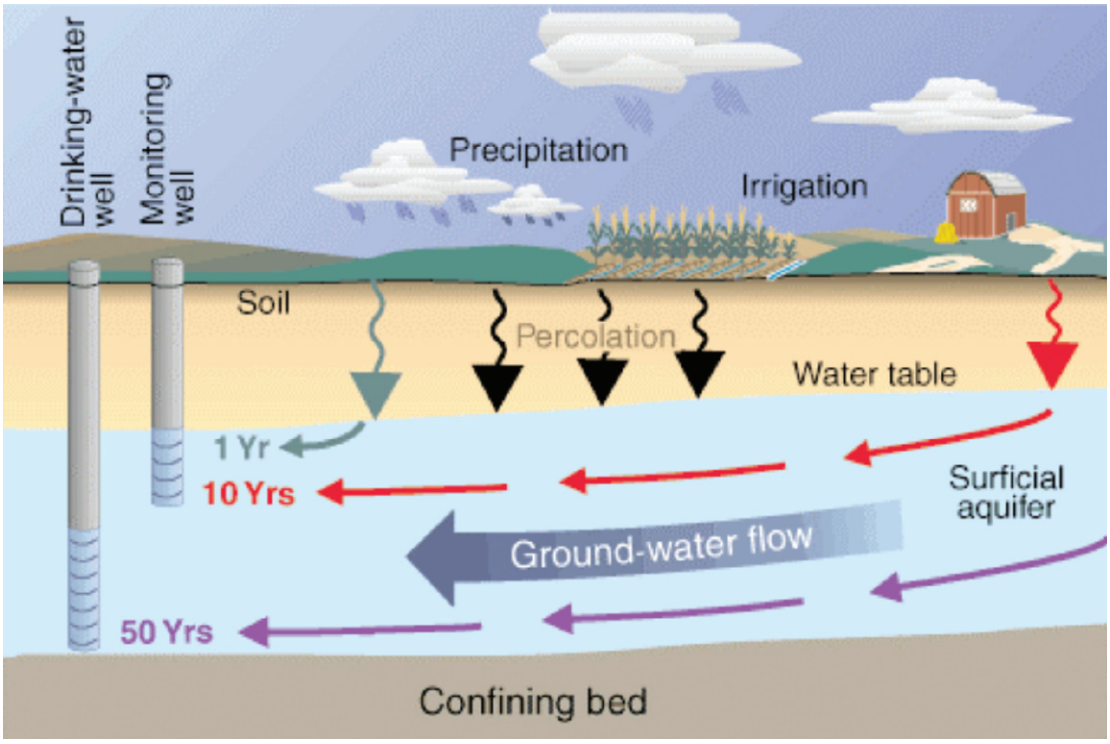
- Sprawl disperses city congestion while the affordability of transportation still allows people to work in the city. Many people move from congested cities to live the country life. They feel that moving into rural areas offers a quieter and more aesthetic environment.
- Sprawl provides an economic mix for growth. By bringing in many people from different areas, cities get a better economic labor force. Different types of people can also help boost a rural area's economy.
- Sprawl attracts families who perceive suburban areas to have better resources for rearing a family – lower rates of crime, better schools, and a more conducive community for shaping children's values.

Although these reasons sound good to many people, they come with hidden costs. With every housing development built in a rural area, a farm is lost. Farmland is disappearing all around the United States. Today, the U.S. agricultural system produces enough food to meet all of our needs and allows us to feed other people around the world; since 1935, the number of farms in the U.S. has been declining (Edelman), though the average size of farms has increased.

Urban sprawl creates problems for the farmer as well as the people moving into the rural areas. Examples of these challenges include:

- Farming produces some smells that may be offensive to nearby residents. These odors come from animal wastes and the spray chemicals that farmers may apply to their fields.
- Having houses too close to local farms can create problems for the farmers, e.g., trash thrown from vehicles, curious children getting in with the animals, and noise (roosters) complaints from the local residents.
- As more people move into the rural area, the farmers may decide to sell their land to local contractors. This would further reduce the amount of farmland, which in the long run may have a negative effect on what we eat, and diminish the green open space treasured by rural neighbors.

Solutions are being developed to address these problems with farmers and local residents. One new idea is called *Community Supported Agriculture* (CSA). This approach helps both farmers and consumers, who promise to buy local farmers' seasonal crops. The essence of CSA is trust and commitment to one's neighbors. It is also attractive as one knows where one's food comes from and can put a face to your farmer. Do you know where your food comes from (*Activity 7.5-6*)?



Pesticide Contamination of Ground Water (USGS)

Piedmont Region (Central Virginia)

Future of the Tobacco Farm

Virginia was the first permanent English colony in the New World. Surviving in the new land was hard for many of the early immigrants. They needed a way to survive and earn an income. Their primary occupation was to grow a crop called tobacco. It was the first cash crop of America and helped the settlers to survive and prosper. Tobacco has been an important crop in Virginia ever since. Today, however, tobacco production is slowly disappearing in Virginia, causing many farmers to go out of business. Many farmers are losing the way of life that their families have known for centuries. "Most Virginia farms do not grow tobacco, but it is a key crop for those who do" (*Virginia Places*). But recently, due to many different factors, the crop has slowly been disappearing from the area. Cash receipts dropped from $178,315,000 in 1998 to $132,064,000 in 2000 (*Virginia Places*). Today, tobacco is virtually non-existent

One major factor in the decline of tobacco in Virginia is that it is often cheaper to import the tobacco needed for the industry. Many local farmers cannot compete with the lower prices that foreign companies can offer. Another issue with tobacco is that it seriously depletes nutrients in the soil. This makes nutrient management hard. Lands used for growing tobacco are more likely to experience wind and rain **erosion** (Ministry). Farmers must use methods of farming that do not impact the soil. Consequently, tobacco farmers need to use rotation crops to keep erosion down. A common crop for this is rye, which makes an excellent ground cover and helps increase the nutrients in the soil.

Farmers often apply nitrogen or some other nutrient to the soil to make sure there is a nutrient balance in the soil. Before and after application, farmers need to:

- Test the soil for existing nutrients to allow the soil to absorb the nutrients that are applied. This will help maximize plant growth while reducing runoff from excess nutrients, thus enhancing water quality.
- Test plants to see how they use nutrients. This will indicate which nutrients to use to maximize the growth of the tobacco plant.
- After the field crop is planted, walk through and examine the plants. Visual inspection can be the best indicator of needed nutrients (Ministry).

All of these methods are considered part of "Best Management Practices" or BMPs. Many farmers do not have the time or economic resources to do all of this testing and extra planting. Tobacco is a labor-intensive crop, having to be harvested mostly by hand. This discourages many young people from wanting to get into the business. With foreign companies being able to produce tobacco at lower costs and sell it at lower prices, many Southside farmers can't compete, devastating many farmers because it is the only way of life that most of them have known.

Valley and Ridge Region (Shenandoah Valley)

Challenges for the Poultry Industry

Agriculture in the Shenandoah Valley and in most parts of western Virginia is a vital part of the economy. It is one of the largest sources of income for these areas. A major sector of agriculture in these areas is the poultry industry, where chickens and turkeys are grown for a period of time and then sent to a slaughter plant that processes the products that you see every day in the grocery store. Many people love chicken nuggets and strips, but have little knowledge about how they are produced or what happens to the byproducts of their production. On large poultry operations, birds are usually raised on litter (mostly pine shavings) in houses containing thousands of birds.

One of the challenges in Virginia agriculture is how to dispose of these shavings after the birds have gone to the plant. Poultry litter contains high amounts of nitrogen and phosphorus that, in large quantities, is not good for the environment. Many farmers utilize the litter by putting it on fields where they grow crops, helping crops grow faster as the litter adds nutrients to the soil. Some farmers used to feed the litter to beef cattle to fatten them, although concerns over the spread of Bovine Spongiform Encephalopathy (BSE), commonly referred to as "mad cow disease" led the FDA in January 2004 to outlaw this practice.

Fertilizing the land with too much poultry litter can affect the quality of surrounding water bodies and groundwater (Lichtenberg). Adding enough litter to the soil to achieve the appropriate level of nitrogen will cause a surplus of phosphorus, which then contributes to poor water quality. Some scientists consider the increased use of nitrogen and phosphorus on croplands to be a major source of pollution in the Chesapeake Bay. Today, many farmers are required to have an approved nutrient management plan in place to designate how many nutrients can be placed on each field (Lichtenberg). This policy approach gives the farmer some incentive and guidance in protecting the environment and water quality in their **watershed.** Several factors should be considered before using poultry litter on cropland:

- ***Marginal Value:*** How much added revenue are you going to get from using poultry litter on your land? Is it economically feasible to spread the litter onto the land?
- ***Application Costs:*** How much will it cost in equipment and labor to apply the fertilizer to your land?
- ***Transportation Costs:*** Are there poultry facilities nearby to provide the litter at a cost lower than the alternatives?
- ***Potential Pollution:*** Are there already sufficient amounts of nitrogen and phosphorus in the soil to sustain your crops such that additional nutrients added would cause runoff and/or percolation into groundwater and be harmful to the environment? (Lichtenberg).

All of these factors must be considered by the farmer and the scientists involved before poultry litter may be used on croplands. If these points are ignored, then the ecosystems of local watersheds may be negatively affected. Mistakes made locally could also affect ecosystems farther away, such as the Chesapeake Bay.

There are other uses for poultry litter besides its use on croplands. Currently in Minnesota, a power plant called Fibrominn is developing technology that would allow it to use poultry waste to produce electricity. Predictions are that, "It will be able to generate 50 megawatts of electricity from 500,000 tons of poultry litter every year" (Ag Journal). This market-based alternative gives poultry producers a year-round option for disposal of their litter that generates additional revenue. Another potential benefit to this new idea is that the ash produced from burning the litter for electricity might also be used as a fertilizer on crops (Ag Journal). This idea could benefit not only the poultry industry, but Americans as well as a secondary fuel source.

Scale model of Fibrominn generating plant shown at the 2002 Midwest Poultry Federation convention (Ag Journal).

Sustainable Agriculture

"development which meets the needs of current generations without compromising the ability of future generations to meet their own needs"

– Brundtland Commission on Sustainable Development, 1987

While regions differ from each other, all farmers share something in common. Every farmer feels a sense of fulfillment as he surveys his green pastures, her healthy herd of cattle, or their lush crops

that flourish in the morning sun. Hard work and dedication to production enables our nation to have three meals everyday. With a growing population, the need for successful crops and high yields is ever more critical. Some farmers have boosted production through chemical means; others have chosen to investigate the benefits of genetically modified crops. However, not all methods are sustainable.

Sustainability was first defined by the Brundtland Commission on Sustainable Development in 1987 as meeting the needs of current generations without compromising the ability of future generations to do so. In other words, sustainability promotes a way of life which can be maintained over long periods of time (http://www.unece.org/oes/nutshell/2004-2005/focus_sustainable_development.htm).

Sustainable agriculture encompasses several broad goals. They include: providing a more profitable farm income, promoting environmental stewardship, and promoting stable farm families and communities. These goals are achieved through carefully planned land management practices such as the use of cover crops, minimal application of chemicals, maintaining top soil quality, limiting erosion marketing one's goods locally, rotational grazing, and crop rotation.

Farmers may implement certain Best Management Practices, or BMPs, to ensure that the nearby water quality is not degraded. Some of these practices include proper management of animal waste, using rotational grazing to keep pastures from becoming over-grazed (causing erosion), and using soil tests to accurately determine how much fertilizer is really needed so that excess chemicals do not contaminate the waterways. There are various incentives for farmers to use these practices. In 1996, the Virginia General Assembly enacted the Virginia Agricultural BMP Tax Credit Act, which allows any individual in production farming to claim a tax credit for BMPs that are installed to improve water quality. There are other organizations, such as the federal Sustainable Agriculture Research and Education (SARE) program, that give farmers grants to help implement BMPs into their farm plans. By using BMPs, these agriculturalists are practicing **sustainable agriculture**, a production and distribution system that minimizes the negative impacts on health, safety, wildlife, water quality and the environment, as well as optimizing use of available resources (USDA).

One cattleman featured on the Sustainable Agriculture Network website was concerned about the decline in prairie vegetation present on his ranch. In 1994, Jeff Mortenson, the owner of the ranch, received a grant to establish native plants on the ranch. Since then, he has saved money on feed costs and is able to significantly reduce soil erosion. Another farmer received a grant and implemented a four-year crop rotation practice on his farm, which included cover crops and conservation tillage. On the website of the USDA's Sustainable Agriculture Research and Education (SARE) program, Matthews said: "Measurements show we're losing less . . . soil. We've also learned we're making more money on the sustainable projects because we're spending less" (USDA).

In many western states, water availability is a serious problem and limiting factor in crop yields. Crops are often irrigated to obtain the needed moisture. Clean, usable water, however, is not available in endless amounts. One method for increasing water-holding capacity in soils is to increase the organic matter in those soils. Spreading animal waste or planting a green cover crop is a viable solution.

Sustainable agriculture focuses on these kinds of practices. By using cover crops to reduce erosion and increasing the amount of organic matter in the soil, farmers are able to cut back on the need for chemical fertilizer, which saves money and is better for the environment.

Developed in 1988, SARE has sponsored many projects in order to explore the possibilities of implementing sustainable agriculture programs all over the United States. Annual grants are available for researchers and producers ranging from $500 to $5,000. Universities and nonprofit organizations can be awarded $30,000 to $200,000 for research and education projects (USDA).

According to the SARE grants information page, Virginia has received $2,844,647 to support 42 projects. Projects range from research designed to enhance agricultural understanding in urbanized areas, discovering alternative control of soil diseases on vegetable production, increasing honeybee production, and using compost tea to enhance the growth of pastures for grazing animals. While Virginia Tech researchers lead many of these projects, members of different organizations and agricultural producers are conducting a large portion of the research (USDA).

In the western region, the SARE/ACE project is focusing on "preserving wetlands and improving habitat while producing root vegetables and cereals in pathogen-free soil." Periodic flooding of wetlands can improve habitat during the flood stages so that the soil can be used for agricultural purposes during the dry season. "We need to sustain agriculture and improve wildlife habitat . . . one strategy is to flood areas of cropland to create new diverse wetlands and to drain areas to create cropland free of soil-borne pathogens," says Carol Shennan, the UC-Davis-based project manager, in comments posted on the site (USDA).

Another major area of research is better utilization of the southern woodlands. The project focuses on "selective timber harvesting" where trees are harvested when the maximum income can be generated and the land is managed to provide hunting, fishing, and other forms of recreation.

An inspiring aspect of sustainable agriculture is present when entire communities get involved. The gains of a sustainable agriculture program integrated into an urban community are multi-dimensional. Farmers who grow a variety of fruits and vegetables gain a dedicated market. Students not accustomed to fresh produce receive fruits and vegetables every day. Finally, the city community learns about agriculture, nutrition, and the environment through various workshops and demonstrations.

Sustainable agriculture has many benefits: it brings more profit to the producer, is better for our environment, and can be used to benefit the entire community. Producers are able to reduce fertilizer costs if a crop rotation is properly utilized and soil loss due to erosion can be decreased with the use of a winter cover crop such as rye, crimson clover, Austrian winter pea, or other types of winter annual. Sustainable agriculture may prove to be essential for feeding our growing nation. With only two percent of our citizens responsible for providing our nation's food supply, some measures must be taken. One key factor involves education and application of sustainable agriculture practices. For more information go to www.sare.org or visit your local extension agent (USDA).

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7.4 Materials List

7 – 1 Regarding pesticides, "A little goes a long way."

- Activity sheet
- Bleach
- Dropper
- Test tubes in rack
- pH indicator

7 – 2 Alternative uses for tobacco

- Activity sheet
- Computers
- Library resources

7 – 3 "Too much of a good thing is a bad thing"– Use of excess fertilizer

- Activity sheet
- Soil test kit

7 – 4 Controlling soil erosion

- Activity sheet
- Aluminum or plastic tray
- 2 cups of soil (plain dirt from garden!)
- Variety of objects such as toothpicks, cotton balls, gauze, twigs, plastic, aluminum foil, leaves
- Watering can with sprinkler head

7 – 5 Growth of algae due to fertilizers

- Activity sheet
- 4 clear glass pint jars
- Pond water (Safety note – hands should be thoroughly washed after any handling of pond water – giardia spores can remain on dry hands for several hours.) Aquarium water can also be used.
- Liquid fertilizer or granular fertilizer that has been dissolved in water.

7 – 6 Where does your food come from?

- Activity sheet
- Map of the United States/world with cities and distances between

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7.5 Activities

7 – 1 Regarding pesticides, "A little goes a long way."

Using bleach diluted in water will provide students with an example of pesticide runoff.

7 – 2 Alternative uses for tobacco

Students research the uses of tobacco in products other than cigarettes.

7 – 3 "Too much of a good thing is a bad thing"– Use of excess fertilizer

Students will test the soil around the school and compose letters to the school director of buildings and grounds giving the information collected and recommendations on fertilizers that could be used.

7 – 4 Controlling soil erosion

Conceptual plans for decreasing erosion and runoff will be contemplated and then tested for effectiveness.

7 – 5 Growth of algae due to fertilizers

Students will perform an experiment that looks at the effects of fertilizers on algae growth in water.

7 – 6 Where does your food come from?

Students will learn how many food miles are associated with certain products.

Teacher Page

7 – 1 Regarding pesticides, "A little goes a long way."

Purpose

This activity models how even a small amount of a hazardous material may present a problem if it gets into water.

Materials Needed

- Activity sheet 7.5.1 for each student
- 1 mL of bleach
- dropper
- 10 mL small vials or test tubes in rack
- pH indicator-may be obtained from aquarium supply store

Safety

Goggles, gloves, and long sleeves should be worn when working with bleach! *Wash hands often.*

Procedure

- Test pH of bleach.
  Answer: approximately pH 9+
- Put 10 mL of water from tap into a vial.
- Test pH of water as control.
  Answer: approximately pH 7
- Pour water out of test tube and pour in 1 mL of bleach. Add 9 more mL of water. Test pH.
  Answer: approximately pH 9
- In new test tube, pour 5mL of the bleach/water mix. Fill remainder of test tube with water. Test pH.
  Answer: approximately pH 9+
- Repeat previous step several times until pH of test is same as pH of control.

Reflection

How many times was it necessary to dilute the bleach until it was not detected in the water?
Answer: A minimum of 10 dilutions

Discuss how you think this example could be used to describe the problem of pesticide runoff into water source?
Answer: Very small amounts of chemicals can contaminate large volumes of water. Pesticides can biomagnify to harmful levels in living things

Student Page

7 – 1 Regarding pesticides, "A little goes a long way."

Safety

Goggles, gloves, and long sleeves should be worn when working with bleach! *Wash hands often.*

Procedure

- Test pH of bleach.
  Answer:

- Put 10 mL of water from tap into a vial.

- Test pH of water as control.
  Answer:

- Pour water out of test tube and pour in 1 mL of bleach. Add 9 more mL of water. Test pH.
  Answer:

- In new test tube, pour 5mL of the bleach/water mix. Fill remainder of test tube with water. Test pH.
  Answer:

- Repeat previous step several times until pH of test is same as pH of control.

How many times was it necessary to dilute the bleach until it was not detected in the water?
Answer:

Reflection

Discuss how you think this example could be used to describe the problem of pesticide runoff into water source?
Answer:

7 – 2 Alternative uses for tobacco

Have students research the uses of tobacco (and specifically nicotine – the active ingredient in tobacco) in products other than cigarettes.

Teacher Page

7 – 3 "Too much of a good thing is a bad thing." – Use of excess fertilizer

Purpose

Students will learn how to test soil to determine the amount of nutrients needed.

Materials Needed

- Activity sheet 7.5.3 for each student
- Soil test kit – may be purchased from lawn/garden supplier or obtained from local Cooperative Extension Service office for a small fee. (http://www.ext.vt.edu/offices/)

Procedure

- Follow directions on soil sample box and take sample of soil in area surrounding our school.
- Submit sample for testing.
- Once results are returned, we will compose letters to the school division director of buildings and grounds, giving the information collected and recommendations for fertilizers needed for the school green spaces.
- *Enrichment activity* – calculate the area of the school green space (a review of how to make area measurements and calculations may be necessary). Use the area measurements and a commercial fertilizer blend to calculate the amount of fertilizers to buy and apply.

Reflection

What does the soil test tell you?

Answer: Tells how acidic or alkaline the soil is.

How could testing the soil help a farmer?

Answer: The farmer would know what nutrients (fertilizers) need to be added to the soil.

What problems do you think would occur if a farmer does not have his/her soil tested?

Answer: The farmer could add too much fertilizer to the soil or could not add enough.

Student Page ***7 – 3 "Too much of a good thing is a bad thing." – Use of excess fertilizer***

Procedure

- Follow directions on soil sample box and take sample of soil in area surrounding our school.
- Submit sample for testing.
- Once results are returned, we will compose letters to the school division director of buildings and grounds, giving the information collected and recommendations for fertilizers needed for the school green spaces.
- *Enrichment activity* – calculate the area of the school green space (a review of how to make area measurements and calculations may be necessary). Use the area measurements and a commercial fertilizer blend to calculate the amount of fertilizers to buy and apply.

Reflection

What does the soil test tell you?

Answer:

How could testing the soil help a farmer?

Answer:

What problems do you think would occur if a farmer does not have his/her soil tested?

Answer:

Teacher Page — *7 – 4 Controlling soil erosion*

Purpose

Students will demonstrate understanding of erosion control by building a model.

Materials Needed

- Activity sheet 7.5.4 for each student
- Aluminum or plastic tray
- 2 cups of soil (plain dirt from garden!)
- Variety of objects such as toothpicks, cotton balls, gauze, twigs, plastic, aluminum foil, leaves
- Watering can with sprinkler head or a spray bottle

Procedure

- Place 2 cups of dirt in center of tray.
- Brainstorm how to prevent water from running off or eroding soil from dirt mound – decide which materials to use.
- Build their soil erosion model.
- Using a watering can with a sprinkler head or a spray bottle, sprinkle your model with ¾ to 1 cup of water.
- Compare your model to other groups to see which is most successful design for preventing soil erosion.

Reflection

Describe your model – what materials did you use to prevent erosion?

Look at models built by other groups. Describe the model that best seemed to prevent runoff and erosion.

Answer: Most likely the model that best prevents runoff would be one with materials breaking the force of water on soil, especially on steep slopes.

How could a farmer use these ideas to prevent soil erosion on his/her fields?

Answer: The farmer might want to use natural materials like grass, trees, etc. . . . to cover steep slopes. Plant roots are one of the only successful preventative techniques for erosion. Roots have a mutualistic relationship as they absorb nutrients and water while providing an *ecosystem service*.

Student Page

7 – 4 "Too much of a good thing is a bad thing"– Use of excess fertilizer

Procedure

- Place 2 cups of dirt in center of tray.
- Brainstorm how to prevent water from running off or eroding soil from dirt mound – decide which materials to use.
- Build their soil erosion model.
- Using a watering can with a sprinkler head or a spray bottle, sprinkle your model with ¾ to 1 cup of water.
- Compare your model to other groups to see which is most successful design for preventing soil erosion.

Reflection

Describe your model – what materials did you use to prevent erosion?

Look at models built by other groups. Describe the model that best seemed to prevent runoff and erosion.

Answer:

How could a farmer use these ideas to prevent soil erosion on his/her fields?

Answer:

Teacher Page

7 – 5 Growth of algae due to fertilizers

(this activity may be done as whole class activity).

Purpose

Farmers use fertilizers to increase the productivity of their land. Many environmentalists are concerned about the effect that fertilizers have on the growth of algae in water. This activity looks at the effect that fertilizers have on algae in the water.

Materials Needed

- Activity sheet 7.5.5 for each student
- 4 clear glass pint jars
- Pond water (*Safety note* – hands should be thoroughly washed after any handling of pond water – giardia spores can remain on dry hands for several hours.) Aquarium water can also be used.
- Liquid fertilizer or granular fertilizer that has been dissolved in water.
- Dropper
- 10 mL graduated cylinder

Safety

Goggles should be worn when working with fertilizers! Wash hands often and clean work area when finished.

Procedure

- Label the four jars A, B, C, D.
- Fill each jar about ¾ full of pond water.
- In jar B put 1 drop of liquid fertilizer.
- In jar C put 10 drops of liquid fertilizer.
- In jar D put 5 mL of liquid fertilizer.
- Place all four jars in the window and observe every day for one week. On the back of this sheet draw what you see every day.

Reflection

Which jar had the most growth of algae by the end of the week?

Answer: Jar C or D

Which jar had the least?

Answer: Jar A

What is the purpose of jar A in an experiment like this?

Answer: Jar A is the control

How would this kind of chemical get into streams, rivers, and lakes?

Answer: By washing off soil to which it has been applied – lawns, crops, golf courses, etc.

How does this model relate to environmental concerns over fertilizers in water?

Answer: Excess fertilizers in streams, rivers, and lakes cause unwanted growth of plants and algae in water.

What is the problem caused by too much algae in water?

Answer: The process by which fertilizers enter waterways, promote algal growth, and decrease oxygen levels is called eutrophication. This occurs when the organic material dies, and decomposes at the bottom of a water source. Decomposition uses an incredible amount of dissolved oxygen creating an anoxic zone. Also, algal growth at the surface blocks sunlight, changing living conditions, especially at medium depths.

Teacher Page

7 – 6 Where does your food come from?

Background

A particular challenge to our food future is obtaining local sources for consumption, that do not take large amounts of energy to transport. This activity makes one aware of this challenge by showing how many food miles are associated with certain products. This activity can be done in ones house or at the grocery store. Most foods have stickers or cities from which they come. A reference sheet of how far major cities or states are from where "you" are can be made too.

Procedure

Use the table to fill in food, location of where it comes from, and distance from you. Average the distance at the end of the activity.

Food in your house or grocery store:	*Where this food comes from:*	*Miles from where you live:*
1.		
2.		
3.		
4.		
5.		
	Total miles average per food:	

Website for estimated distance between major United States cities:
http://www.mapcrow.info/united_states.html

Reflection

How far does the average food product travel to get to your house or grocery store?
Answer: Will vary, most produce travels 1500 miles to get to your dinner table (http://www.nrdc.org/health/foodmiles/)

What about for the ingredients?
Answer: Exponentially increases miles

What are the ingredients, substances necessary to produce your food? Does this increase or decrease the "food miles" associated with the product?
Answer: Feed for animals, fertilizers, pesticides, and ingredients can all increase food miles significantly.

How far for the class?
Answer: will vary

What are some solutions to the future problem of finding local, low energy foods?
Answer: Buying local, finding CSAs, growing one's own food, canning, and eating in season are all viable answers.

Student Page

7 – 6 Where does your food come from?

Background

A particular challenge to our food future is obtaining local sources for consumption, that do not take large amounts of energy to transport. This activity makes one aware of this challenge by showing how many food miles are associated with certain products. This activity can be done in ones house or at the grocery store. Most foods have stickers or cities from which they come. A reference sheet of how far major cities or states are from where "you" are can be made too.

Procedure

Use the table to fill in food, location of where it comes from, and distance from you. Average the distance at the end of the activity.

Food in your house or grocery store:	*Where this food comes from:*	*Miles from where you live:*
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Website for estimated distance between major United States cities:
http://www.mapcrow.info/united_states.html

Reflection

How far does the average food product travel to get to your house or grocery store?
Answer:

What about for the ingredients?
Answer:

What are the ingredients, substances necessary to produce your food? Does this increase or decrease the "food miles" associated with the product?
Answer:

How far for the class?
Answer:

What are some solutions to the future problem of finding local, low energy foods?
Answer:

7.6 References

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